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Forest Pest Management Report

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BIOLOGICAL EVALUATION
Western Spruce Budworm

Lincoln National Forest
New Mexico

December 1982

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USDA Forest Service, Southwestern Region
State and Private Forestry
Forest Pest Management
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ABSTRACT

The western spruce budworm, _Choristoneura occidentalis_ Free., defoliated approximately 6,625 acres of mixed conifer forest on the Lincoln National Forest and Mescalero Apache Indian Reservation in 1982. A survey conducted in August 1982 estimated egg mass densities at 35.9/m^2 foliage. Defoliation is predicted to be heavy in 1983 with the infestation areas expanding.

Pest management alternatives and recommendations are discussed in this report.

INTRODUCTION

The western spruce budworm, Choristoneura occidentalis Free., is a principal insect defoliator of mixed conifer forests in New Mexico. In 1982, defoliation was detected on the Lincoln National Forest and Mescalero Apache Indian Reservation in amounts representing a substantial increase over the previous year. As a result, an egg mass survey was conducted in August 1982 to determine the infestation trend and predict 1983 defoliation levels. Management alternatives and recommendations are discussed.

LIFE HISTORY OF WESTERN SPRUCE BUDWORM

In New Mexico, the western spruce budworm's preferred hosts are Doulgas-fir, Pseudotsuga menziesii (Mirb.) Franco, and white fir, Abies concolor (Gord. and Glend.) Lindl. Subalpine fir, Abies lasiocarpa (Hook.) Nutt., Engelmann spruce, Picea engelmannii Parry, and blue spruce, Picea pungens Engelm., are also attacked.

The western spruce budworm has one generation per year in New Mexico. Adult moths emerge and mate in July. Females may lay a partial complement of eggs shortly after mating; the remainder are deposited after a disperal period. Eggs are found in masses cemented to the undersides of host tree needles and hatch in about 10 days. The newly hatched larvae do not feed, but seek hiding places under bark scales and on twigs where they spin silken shelters (hibernacula) and overwinter.

In the spring, larvae disperse to the foliage where they mine old needles and buds for 1 to 2 weeks. As buds open and new shoots expand, larvae move onto the new growth and feed, often webbing shoots together. Larvae prefer to feed on new foliage and mature in 30 to 40 days after feeding commences in the spring. Pupation takes place on the foliage. Adult moths are not strong flyers, but may be carried considerable distances by air currents.

EVIDENCE OF INFESTATION

Budworm-caused defoliation intially appears in the crowns of overstory trees where the current year's foliage is consumed. During peak defoliation periods (late June and early July), crowns appear reddish, resulting from the browning of chewed needles caught in feeding webs. As the outbreak progresses, defoliation becomes more severe, particularity on understory trees. Several consecutive years of defoliation causes crowns to appear grayish as branch dieback and top-kill begin.

EXTENT OF OUTBREAK

Defoliation was aerially detected in 1982 on the Cloudcroft and Smokey Bear Ranger Districts and the Mescalero Apache Indian Reservation (figures 1, 2, and 3). Defoliation extimates are as follows:

	Defoliation			
	Light	Moderate	Heavy	Total
Lincoln NF	3,710	80	310	4,100
Mescalero Apache IR	2,525	--	--	2,525

Defoliation in 1981 was aerially detected on only 625 acres on the Lincoln National Forest.

THREATENED RESOURCES

There are approximately 187,000 acres of mixed conifer forest type on the Lincoln National Forest, of which only a small percentage is currently budworm infested. These infested stands display only one year's defoliation (1982). No permanent tree damages have yet occurred.

The severity of tree damage caused by the western spruce budworm is directly related to the intensity and duration of defoliation. Stands displaying good vigor and growth can withstand occasional or possibly two to three consecutive years of intense budworm feeding without significant injury. However, stands displaying poor vigor and growth (overmature or overstocked stands) will suffer varied amounts of tree injury early in the outbreak cycle.

Generally, budworm infestations cause varied amounts of tree deformity, seedling damage, seed destruction, and stand regeneration failure. Stands subjected to four or more consecutive years of severe defoliation incur top-kill and mortality, principally in the smaller size classes. Radial growth of defoliated trees is greatly reduced through the outbreak duration. Tree damages may be quantified as follows:

Tree damages	Maximum damages (percent)
Growth loss	30
Understory mortality	25
Sawtimber mortality	5
Top-killing	25
Cone Crop reduction	90+
Christmas tree quality loss	90+

RECENT HISTORY OF BUDWORM ON LINCOLN NATIONAL FOREST

Lessard (1975) summarized western spruce budworm activity within the Region. In 1952 on the Lincoln National Forest, an infestation was detected in the Sacramento Mountains. This infestation was treated with DDT in 1954 (3,700 acres) and in 1955 (76,000 acres). Budworm populations remained endemic until 1963, when defoliation was again detected. During the period 1964 to 1967, approximately 90,000 acres were annually defoliated. Concern was expressed over damage to commerical Christmas tree areas; however, no suppression was undertaken. Budworm populations apparently declined in 1968 and remained undetectable until 1975. In 1975, the budworm defoliated approximately 5,900 acres (Acciavatti 1975). However, the prediction for 1976 was undetectable defoliation. Budworm defoliation was not detected again until 1981, when aerial surveys revealed approximately 625 acres defoliated on the Cloudcroft Ranger District.

METHODS

Egg mass surveys are the principal tool in evaluating budworm population trends and subsequent defoliation. In August, an egg mass survey was conducted on the Cloudcroft Ranger District. Samples were taken from 17 plots with visible budworm defoliation (figure 1).

Sample plots consisted of three dominant or codominant Douglas-fir within close proximity. Two 70 mm foliated branches were pruned from the midcrown of each sample tree, for a total of six branches per plot. The foliage samples were bagged, labeled, and transported to a laboratory to determine new egg mass densities. Samples were stored in a walk-in cooler at about 40° F.

In the laboratory, the foliage was examined under ultraviolet light for budworm egg masses. Egg masses were separated as old or new by an experienced biological technician. Densities were expressed as numbers of new egg masses per meter square of foliage.

Defoliation predictions are based on estimated egg mass densities using gudielines developed by McKnight et al. (1970):

Egg mass density[1]	Predicted defoliation class[2]
<1.55	Undetectable for all infestations
1.71 to 6.20	Undetectable for "static" infestations Light for "increasing" infestations

Egg mass density[1]	Predicted defoliation class[2]
9.30 to 31	Light for "static" infestations Moderate for "increasing" infestations
>34.10	Moderate for "static" infestations Heavy for "increasing" infestations

[1] Number of egg masses per square meter of foliage.
[2] Defoliation class limits (percent of new growth)
Undetectable = <5%
Light = 5 to 35%
Moderate = 35 to 65%
Heavy = >65%

All samples were taken on the Cloudcroft Ranger District. Active budworm infestations on the Smokey Bear Ranger District and the Mescalero Apache Indian Reservation were not easily accessible and were not sampled.

RESULTS AND DISCUSSION

Sampling results are presented in table 1. Egg mass densities ranged from 6.8 to 74.4 new egg masses per meter square foliage (EM/m^2). The average density was 35.9 EM/m^2, with a 14 percent standard error. Based on this year's survey, the apparent ratio of new to old egg masses was approximately 1:1. Generally, moderate defoliation (35 to 65% new growth) was observed at sample locations.

Based on 35.9 EM/m^2, the defoliation prediction for 1983 is heavy (>65% new growth). The ratio of new to old egg masses appears static; however, the defoliation trend, based on aerial surveys in 1981 and 1982 and the current egg mass density, suggests the infestation will expand in 1983.

MANAGEMENT ALTERNATIVES

There are four possible management actions which can be applied against the current budworm problem. Briefly, they are:

1. No Action. The budworm infestation is allowed to run its course, regulated only by natural control factors. Any resource damage is assumed acceptable. There are no direct costs associated with this alternative.

2. Direct Suppression. Infested areas are aerially treated with an insecticide, either a chemical or microbial. The benefits of this action are twofold--budworm population reduction and foliage protection. The costs of an insecticide treatment range from $8 to $10 per acre, depending on the treatment area size. An insecticide treatment applied during the early years of an outbreak may provide protection from serious budworm defoliation for up to 5 years, based on a pilot project conducted on the Santa Fe National Forest in 1977.

There are three insecticides registered with the U.S. Environmental Protection Agency which are recommended for use against the budworm. These are carbaryl, acephate, and Bacillus thuringiensis (B.t). Carbaryl and acephate are chemcial insecticides, while B.t. is a naturally occurring bacterium.

3. Protection of High-Value Trees. Individual or groups of high value trees can be protected from defoliation by from-the-ground applications of insecticides. High-value trees can be defined as those in campgrounds, picnic grounds, other administrative sites, or mountain home properties where the physical or esthetic damage caused by budworm represents a substantial loss to the objectives of the area. Costs of this action may range from $4 to $6 per tree. Annual or biennial treatments may be required to provide protection during the outbreak periods. The previously mentioned insecticides are also registered for this purpose.

4. Silvicultural Management. This alternative is a long-range process aimed at reducing stand susceptibility/vulnerability to future budworm outbreaks. Intermediate cuttings to control stocking, improve vigor and growth, and to favor nonhost tree species, as well as regeneration cutting to create singe-storied stands favoring nonhost species, are typical silvicultural approches. Generally, even-aged management techniques are preferred. The silvicultural approach will not have any effect on the current outbreak outcome.

RECOMMENDATIONS

During the outbreak's early stages, all mentioned alternatives are viable. This situation exists now. However, as the outbreak progresses, the effectiveness of insecticidal alternatives diminishes. This occurs for two reasons. First, budworm population densities become too high for the insecticides' ability to reduce to acceptable levels. Second, significant tree damage or loss has occurred, lowering the benefits received from insecticide treatments.

For 1983, the recommended alternative is no action. During this period, we suggest an environmental analysis of the budworm problem be performed. This analysis should lead to the identification of resource values where budworm management may be disirable. Then, the proper alternatives can be selected to mitigate the budworm problem. Possibly one or a combination of alternatives may be appropiate.

LITERATURE CITED

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Lessard, Gene. 1975. The occurrence and control of the western spruce budworm in the Southwestern Region. USDA Forest Serv., Southwestern Region. R-3 75-26. 11 pp.

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TABLE 1.--Egg mass survey results for the Cloudcroft Ranger District, Lincoln National Forest, 1982

Plot number	Egg Masses			1982 defoliation estimate[1]
	Density/m^2 Foliage	No. new	No. old	
1	63.7	9.7	6.2	Moderate
2	24.7	5.5	7.3	Moderate
3	34.0	4.8	3.7	Moderate
4	41.8	5.7	6.8	Moderate
5	18.8	3.3	2.5	Moderate
6	33.2	5.0	12.8	Moderate
7	16.8	2.7	1.5	Heavy
8	24.5	3.8	3.0	Heavy
9	46.3	6.2	3.0	Light
10	54.1	6.0	6.5	Heavy
11	13.7	1.8	1.3	Heavy
12	18.1	2.5	0.8	Moderate
13	74.4	9.8	9.7	Heavy
14	45.0	6.2	10.0	Light
15	71.0	10.0	10.5	Moderate
16	23.1	3.0	3.0	Light
17	6.8	1.3	0.7	Light
Mean (S.E.)	35.9 (5.0)	5.1(0.7)	5.3(0.9)	

[1] Defoliation observed on new growth
Light = <35%
Moderate = 35-65%
Heavy = >65%

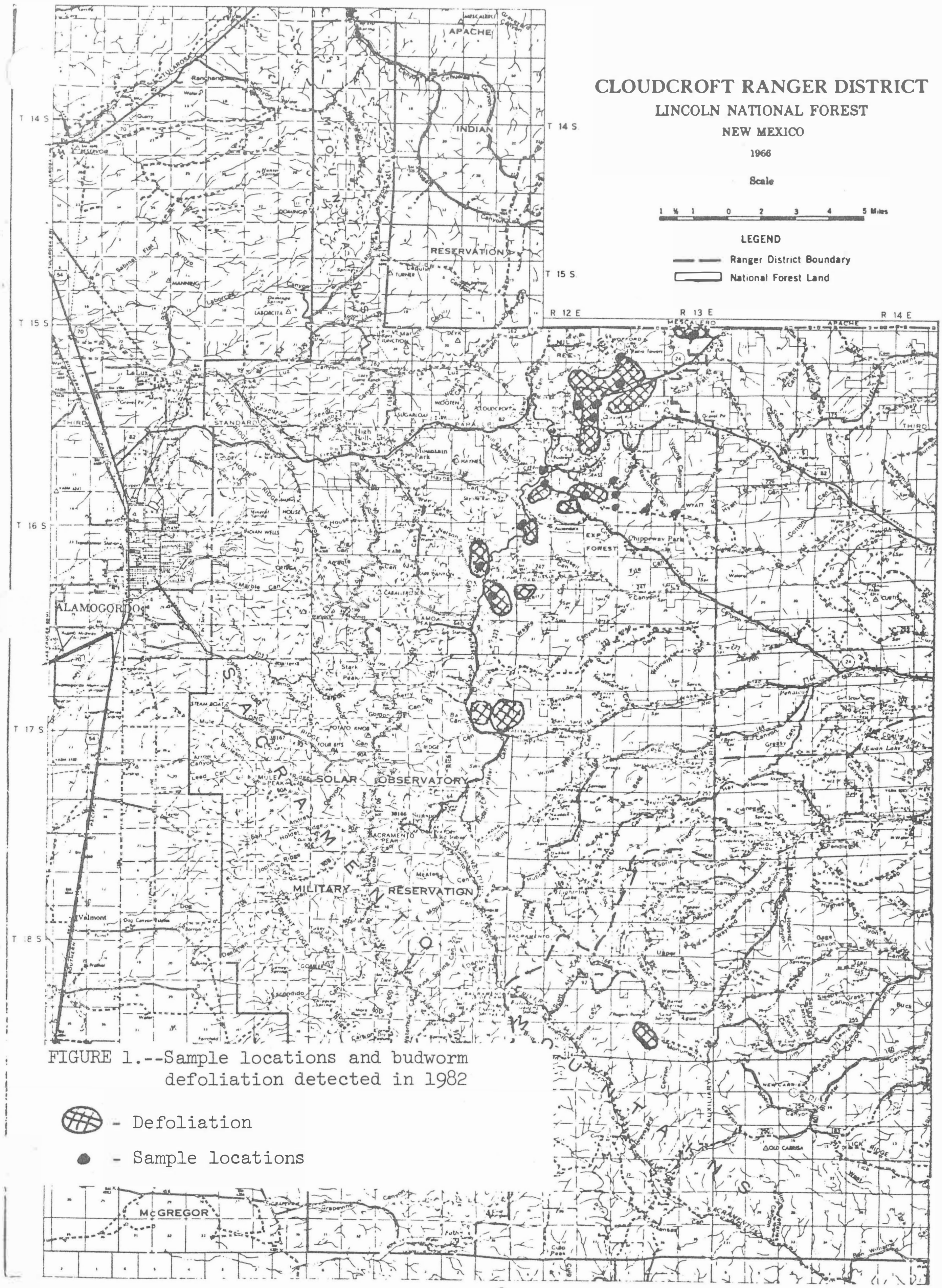

FIGURE 1.--Sample locations and budworm defoliation detected in 1982

- Defoliation
- Sample locations

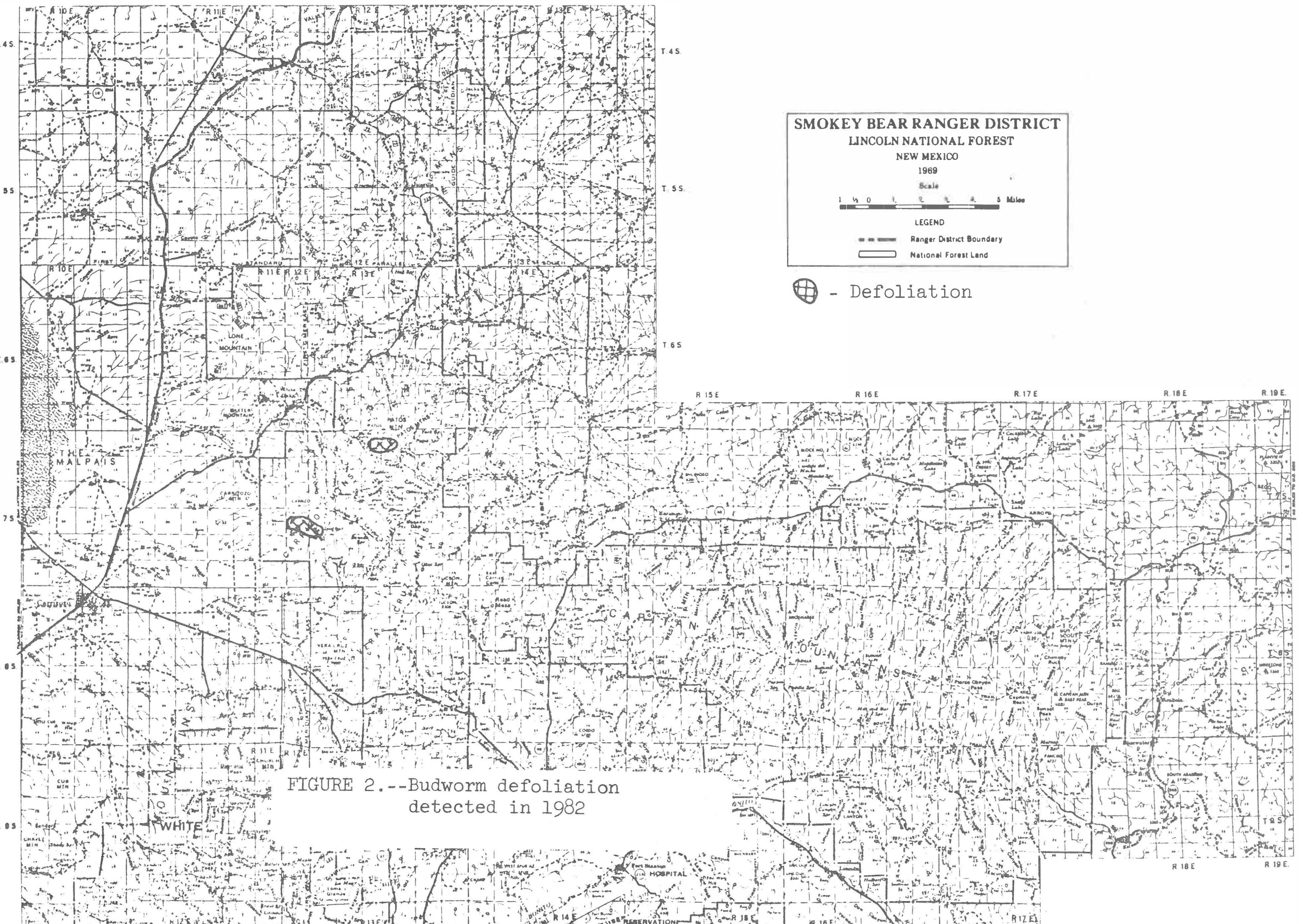

FIGURE 2.--Budworm defoliation detected in 1982

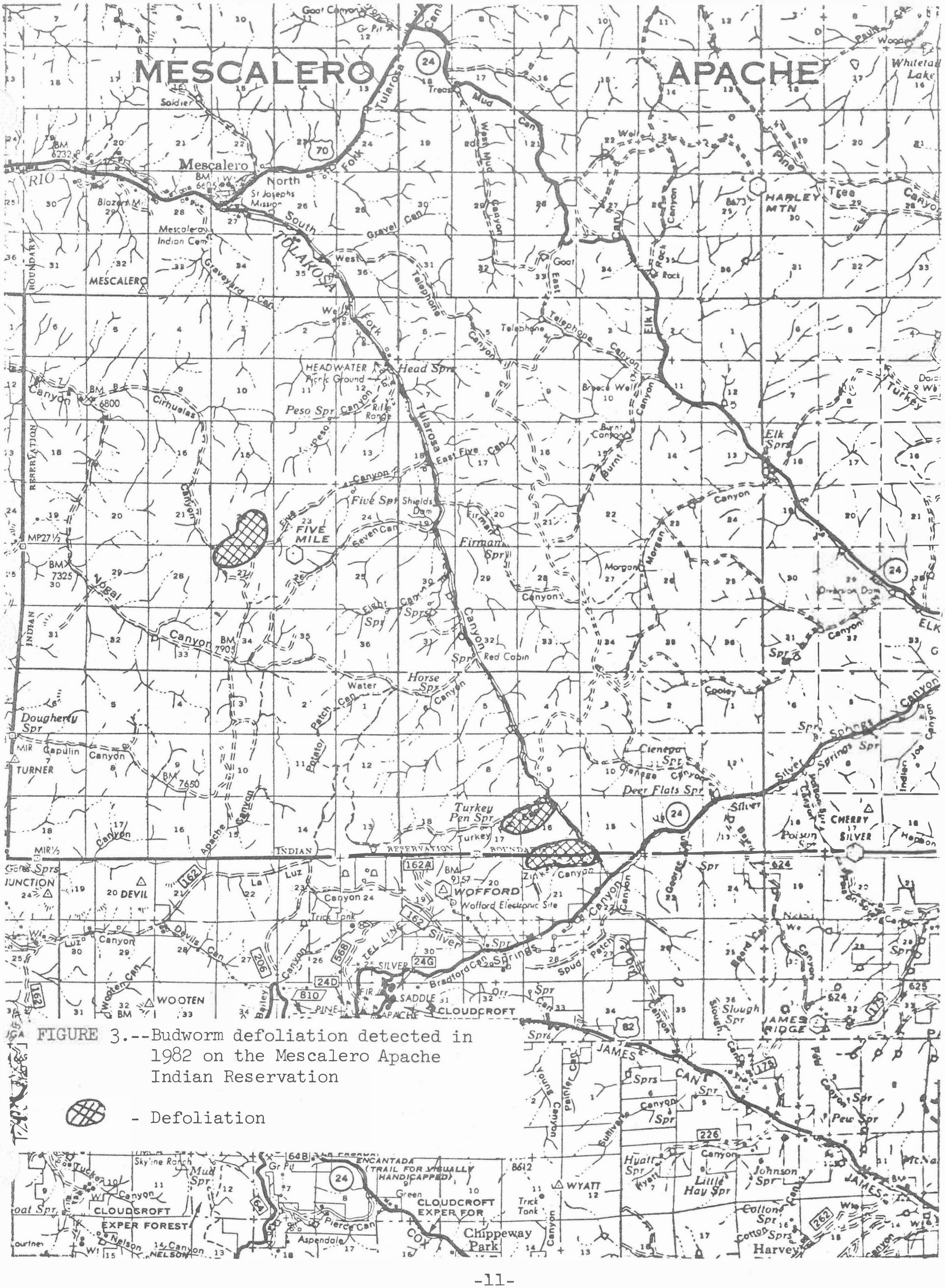

FIGURE 3.--Budworm defoliation detected in 1982 on the Mescalero Apache Indian Reservation

- Defoliation